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(71) Applicant (for all designated States except US): **EASTMAN KODAK COMPANY** [US/US]; 343 State Street, Rochester, NY 14650-2201 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DOWE, David Reynolds** [US/US]; 4821 South Holley Road, Holley, New York 14470 (US). **SCOVILLE, Daniel Jay** [US/US]; 70 Valley Street, Rochester, New York 14612 (US).

(74) Common Representative: **EASTMAN KODAK COMPANY**; 343 State Street, Rochester, ny 14650-2201 (US).

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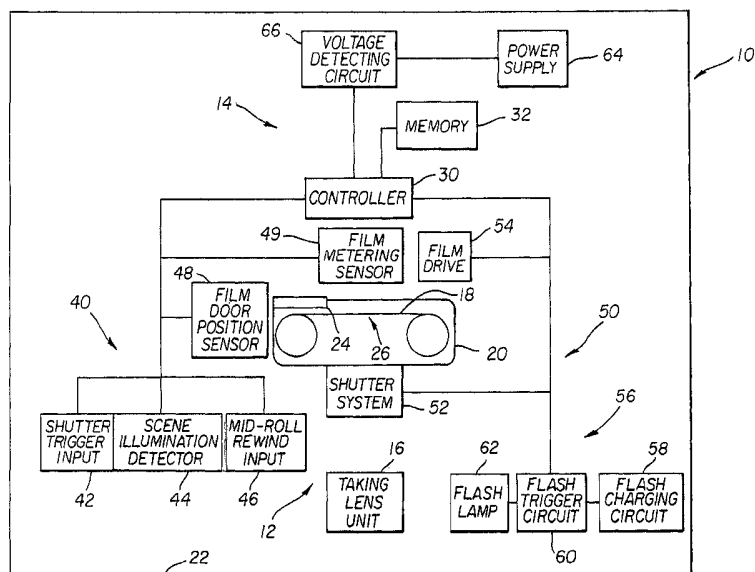
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(54) Title: CAMERA



(57) Abstract: In one aspect of the invention, a camera (10) for use with a power supply (64) is provided. The camera has a voltage detecting circuit (66) adapted to detect a voltage level at the power source and to generate a voltage level signal. An image capture system (12) is also provided and performs a set of image capture operations. A controller (30) receives the voltage level signal and prevents the image capture system (12) from capturing an image when the voltage level signal indicates that there is insufficient power available in the power supply (64) to perform all of the operations in the set of image capture operations.

KAMERA MIT SPANNUNGSKONTROLLE DER STROMVERSORGUNG

FIELD OF THE INVENTION

The present invention relates to cameras with electronically
5 controlled elements and more particularly to camera systems having finite power
supplies.

BACKGROUND OF THE INVENTION

Film cameras have been developed with electro-mechanical
systems that support automatic functions such as film winding, film rewinding,
10 exposure control, electronic flash, etc., all controlled by a controller such as a
microprocessor. Electrical energy is provided to such electro-mechanical systems
and the controller by a power supply. Most often, the power supply is a chemical
battery of conventional design that stores a fixed amount of potential energy and
releases this potential energy in the form of electricity. As this electricity is used,
15 the amount of power remaining in the power supply is reduced. After extended
operation, the potential energy stored in the power supply can be reduced to a level
that is insufficient to allow the camera to reliably perform certain camera
operations.

The amount of potential energy stored in the power supply can be
20 determined based upon the difference of potential or voltage between electrically
positive and negative terminals of the power supply. As potential energy in the
power supply is reduced, the difference in potential at the terminals lowers.
Accordingly, cameras are known that monitor voltage levels between the terminals
of the power supply and provide a warning when voltage levels at the terminals
25 reach a predetermined low level.

However, it can also be useful to prevent the camera from
attempting to perform functions that cannot be reliably performed when the
camera is in operation. The cameras of the prior art employ various general
strategies to prevent camera mis-operation caused by low levels of available
30 energy in a battery.

One strategy is to modify the operation of certain camera elements in order to ensure that the operation of the camera components does not consume so much power as to interfere with the operation the camera. For example, U.S. Patent No. 5,023,470, filed by Onozuka et al. on April 18, 1989 shows an
5 electronic flash charging circuit for use with a camera having a power source common to a microcomputer that controls a plurality of camera functions and to an electronic flash. The charging circuit has a booster circuit for boosting a charging voltage with which a main capacitor of the electronic flash is charged and a controller that causes the booster circuit to operate intermittently. This
10 intermittently charges the main capacitor so that charging the capacitor does not lower the battery voltage below the level necessary to support operation of the microcomputer.

Another strategy involves using the voltage level at the battery to determine whether the operation of the camera microprocessor will be altered by
15 the performance of particular camera functions. U.S. Patent No. 5,027,150, entitled "Camera" filed on June 25, 1991, by Inoue et al. describes a camera system that detects a battery voltage that is below a threshold and suspends camera operation in response thereto. The camera described in the '150 patent also stores data that is in the microprocessor in a backup memory so that such data is not lost
20 when the camera batteries are changed. In still another example of this type, U.S. Patent No. 4,126,874 entitled "Power Supply Circuit for A Camera", filed by Suzuki et al. on December 20, 1976 describes a power supply circuit that uses a delayed testing scheme to test battery voltage levels. In this patent, camera operation is disabled where the voltage levels detected after the delay are below a
25 threshold. This delayed testing is used where the battery response to the testing is such that the battery responds more accurately to testing after the battery has been used for a period of time.

Yet another strategy involves testing the battery under load to determine whether the battery has sufficient energy to support a maximum load
30 that may occur during camera operation. Where the monitoring indicates that the load is below the maximum, functions associated with the maximum load are

disabled. For example, Suzuki et al. U.S. Patent No. 4,502,744 describes a battery check procedure that applies an actual load on the camera battery that simulates the maximum load that can be placed on the battery by one of the camera components. The voltage at the power supply is monitored during this maximum
5 load. If this voltage is below a threshold, photography is inhibited.

A further strategy involves determining whether particular functions can be performed and disabling those functions when the camera battery does not have enough energy to perform those functions. For example, U.S. Patent No. 5,500,710 entitled "Source Voltage Monitor for A Photographic
10 Camera", filed by Saito et al. on December 15, 1994 describes a system that applies a load to a battery and tests the battery voltage levels under load prior to release of the shutter to determine whether there is sufficient power in the camera to effect shutter release. Shutter release is prohibited where the voltage levels indicate that there is insufficient power in the camera battery to properly release
15 the shutter. Similarly, U.S. Patent No. 4,611,989 entitled "Voltage Detecting Device" filed by Matsuyama on February 13, 1985 describes a voltage detector that measures voltage during movement of a leader screen on a camera shutter so that an accurate determination can be made as to whether there is sufficient energy in a power supply to effect a normal release of a follower screen. In these patents,
20 shutter release is prohibited where the voltage levels indicate that there is insufficient power in the camera battery.

The systems described above show various means for insuring the particular camera operations do not create a risk of unusual operation by testing the battery to determine whether there is sufficient power to perform one or
25 another of the camera operations. In most automatic cameras, the photographic process involves many operations each of which consumes power. Thus, while there may be sufficient power in the power supply to provide reliable performance of one camera operation, there may not be sufficient power in the power supply to provide reliable performance of that camera operation after other precursor
30 operations have been performed as the camera operations are executed to capture an image. Thus, testing a camera power supply to detect whether there is

sufficient energy in the camera power supply to perform a particular camera function does not always provide an accurate indication as to whether there is sufficient energy to perform the entire set of camera operations.

The alternative strategy of testing voltage levels at a power supply during the photographic process and selectively disabling certain camera functions as is described in certain of the above-cited patents, can be problematic. This is because many photographers can be confused when a camera ceases operation during a portion of a photographic process and can draw the wrong conclusion that the camera mechanical systems have failed when the source of the problem is exhaustion of the power supply.

Thus, what is needed is a camera and method for controlling a camera having a new control strategy that addresses these considerations.

SUMMARY OF THE INVENTION

In one aspect of the invention, a camera for use with a power supply is provided. The camera has a voltage detecting circuit adapted to detect a voltage level at the power source and to generate a voltage level signal. An image capture system is also provided and performs a set of image capture operations. A controller receives the voltage level signal and prevents the image capture system from capturing an image when the voltage level signal indicates that there is insufficient power available in the power supply to perform all of the operations in the set of image capture operations.

In another aspect of the invention, a camera for use with a power supply is provided. The camera has a trigger circuit adapted to generate a trigger signal and a voltage detecting circuit adapted to detect a voltage level at the power supply and to generate a voltage level signal. An image capture system is also provided and executes a set of image capture operations to capture images in response to a capture signal from a controller. The controller receives the trigger signal and the voltage level signal and generates a capture signal when the trigger signal is received and the voltage level signal indicates that there is sufficient power available in the power supply to perform the image capture operations.

In still another aspect of the invention, a camera for use with a power supply is provided. The camera has a trigger circuit generating an activation signal and a voltage detecting circuit adapted to measure the voltage in the power supply and to generate a trigger signal when the voltage in the power supply indicates that the power supply has at least a minimum amount of power. An image capture system is adapted to capture an image in response to the trigger signal. Wherein, the minimum amount of power required is sufficient to complete a set of image capture operations used by the image capture system to capture an image.

In a further aspect of the invention, a method for operating an image capture system of the type having a power supply is provided. In accordance with the method, a trigger signal is detected and a voltage level at the power supply is measured. A set of image capture operations is executed only when a trigger signal is detected and the measured voltage level indicates that the power supply has sufficient power to permit completion of the set of image capture operations.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram of one embodiment of a camera of the present invention having a control system;

Fig. 2 is a flow diagram depicting the steps of a camera initialization operation that can be used in accordance with the method of the present invention;

Fig. 3 is a flow diagram depicting the steps of a standby operation;

Fig. 4 is a flow diagram depicting the steps of a take picture operation;

Fig. 5 is a flow diagram depicting the steps of a wind operation;

Fig. 6 is a flow diagram depicting the steps of a rewind operation;

Fig. 7 is a schematic diagram of another embodiment of a camera control system useful in the camera of the present invention; and

Fig. 8 is a schematic diagram of another embodiment of a camera of the present invention;

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a schematic illustration of one embodiment of a camera 10 in accordance with the present invention. As is shown in Fig. 1, camera 10 has an image capture system 12 and a control system 14. Image capture system 12 comprises a taking lens unit 16 for focusing light from a scene onto a film 18 stored in a film chamber 20 in camera body 22. Camera body 22 has a film door 24 that can be opened to permit film to be moved in and out of camera body 22 and closed to secure film 18 in camera body 22. As will be described in greater detail below, image capture system 12 also comprises a shutter system 52 for controllably exposing film 18 to light from the scene.

Control system 14 has a controller 30 which can be any of a programmable general-purpose microprocessor, a special-purpose camera control microprocessor, or other programmable processor. In one embodiment, controller 30 has a memory 32 containing a program with instructions to be executed by controller 30 during operation. Memory 32 can be integral to controller 30 or can be separate as is shown in the embodiment Fig. 1. Controller 30 receives electronic signals from input systems 40, extracts information from the signals, and uses this information in executing the programmed instructions.

In the embodiment shown in Fig. 1, input systems 40 comprise a shutter trigger input 42, a scene illumination level detector 44, a mid-roll rewind input 46, a film door position detector 48, and a film metering sensor 49. Shutter trigger input 42 is a controllable transducer that generates a signal when a user indicates a desire to capture an image. Shutter trigger input 42 can comprise, for example, a switch that the user of camera 10 can selectively open or close to indicate when the user wants to capture an image. Scene illumination level detector 44 monitors light levels in the photographic scene confronting camera 10 and generates a signal indicative of the light levels in the scene. One example of such a scene illumination level detector 44 is a conventional photocell. Scene illumination level detector 44 can also comprise other conventional light level detection devices and systems.

Mid-roll rewind input 46 is a controllable transducer such as a switch that generates a rewind signal when a user indicates a desire to manually initiate film rewind operations. Mid-roll rewind input 46 can comprise, for example a switch that the user of camera 10 can selectively close or open to indicate when the user wants to manually initiate film rewind operations. A film door position detector 48 generates a signal that indicates when film door 24 is open and when film door 24 is closed. Film door position detector 48 can comprise a transducer such as an electro-mechanical switch or electro-optical switch or electro-magnetic switch.

Film metering sensor 49 monitors movement of film 18 within a film metering area 26 in film chamber 20. In one embodiment, where film 18 has perforations, film metering sensor 49 can comprise an electro-mechanical switch which engages the perforations. The electro-mechanical switch opens and closes as perforations on film 18 are moved through film metering area 26. In another embodiment, film metering sensor 49 comprises an opto-electric switch that photo-electrically senses movement of film 18 by optically detecting perforations on film 18. Other film movement detecting devices can also be used to detect movement of film 18 and to generate a signal from which it can be determined that there has been movement of film 18 within the film metering area 26.

Controller 30 generates signals that operate controlled systems 50. In the embodiment shown in Fig. 1, controlled systems 50 include shutter system 52, a motorized film drive system 54, and a flash system 56. Shutter system 52 comprises an optical barrier located between taking lens unit 16 and film 18. In a rest state, shutter system 52 blocks light from striking film 18. During an exposure, actuators in shutter system 52 move shutter system 52 so that a controlled amount of light from a scene strikes film 18. Motorized film drive system 54 winds film 18 between frames to provide appropriate separation of images between images recorded on film 18 and is also adapted to rewind film 18.

Flash system 56 has a flash charging circuit 58, a flash trigger circuit 60 and a flash lamp 62. Flash charging circuit 58 builds potential in an energy storage device such as a flash capacitor (not shown). Flash trigger circuit

60 receives a flash signal from controller 30 and, in response thereto, causes energy stored in the flash charging circuit 58 to flow to flash lamp 62 to achieve a discharge of flash illumination.

In operation, controller 30 receives input signals from input systems 40 processes the input signals in accordance with the camera control programming stored in memory 32 to generate output signals that cause the controlled systems 50 to perform various functions.

A power supply 64 supplies energy that is used to operate the systems of camera 10. Power supply 64 typically comprises a chemical battery of conventional design that stores a fixed amount of potential energy and releases this potential energy in the form of electricity. The amount of potential energy in power supply 64 is fixed. As image capture system 12, control system 14, input systems 40 and controlled systems 50 operate, the amount of potential energy stored in the power supply 64 decreases. After extended operation, energy stored in power supply 64 can become insufficient to maintain reliable operation of control systems 14, input systems 40 and/or controlled systems 50. The amount of potential energy stored in power supply 64 can be determined based upon the difference of potential between positive and negative terminals (not shown) of power supply 64. As potential energy is removed from power supply 64 to operate the control system 14, the difference in potential is reduced.

A voltage detecting circuit 66 is provided which monitors the voltage level at power supply 64 and generates an output signal based upon the voltage level. Voltage detecting circuit 66 can take many forms. In one embodiment, a TC54 series integrated circuit sold by Microchip Technology Inc., Chandler, Arizona, USA or equivalent is used. Other known voltage detecting circuits can also be used. In the embodiment shown, voltage detecting circuit 66 detects whether the voltage at power supply 64 is above a threshold voltage, for example, a threshold of 2.4 volts. When voltage detecting circuit 66 detects that the voltage across the terminals of power supply 64 is above the 2.4 volt threshold, voltage detecting circuit 66 will produce a first output signal. When voltage detecting circuit 66 detects that the voltage across the terminals of power supply

64 is below 2.4 volts, voltage detecting circuit 66 will produce a second output signal. One sample of such a first output signal is a signal having a difference of potential of 2.4 volts while one example of a second signal is a signal having a ground potential. Voltage detecting circuit 66 can work in other ways. For
5 example, voltage detecting circuit 66 can generate an output signal that is proportional to the voltage level at the terminals.

The signal from voltage detecting circuit 66 is supplied to controller 30 which determines information useful in executing the instructions in the program. In this embodiment, controller 30 monitors the output signal from
10 voltage detecting circuit 66. Where controller 30 detects the first signal from voltage detecting circuit 66, controller 30 is programmed to allow a shutter system 52 to operate. Conversely, where controller 30 detects the second signal from voltage detecting circuit 66, controller 30 is programmed to prevent shutter system 52 from operating. As will be described in greater detail below, the threshold
15 voltage level is determined based upon the requirements of the system to perform a set of more than one image capture operations during an image capture operation.

Figs. 2 – 5 are flow diagrams depicting one embodiment of a method for controlling a camera in accordance with the present invention. Fig. 2
20 shows a film initialization operation. Control system 14 performs the steps of the film initialization operation when control system 14 is activated (step 70). This activation can occur for example when a camera on/off switch (not shown) is moved to an “on” position from an “off” position. Typically, an on/off switch determines whether power stored in power supply 64 is available to be used by
25 controller 30, input systems 40, or controlled systems 50. Where the on/off switch is in the “off” position, no power is supplied. Where the on/off switch is in the “on” position power is supplied and initialization begins. Other known activation systems can also be used.

Once activated, controller 30 samples the signal generated by film
30 door position detector 48 to determine if film door 24 is closed (step 72). If film door 24 is open, controller 30 waits for a delay period to expire (step 74). After

the delay period has expired, controller 30 again monitors film door position detector 48. When controller 30 determines that film door 24 is closed, controller 30 samples the signal generated by voltage detecting circuit 66 to determine whether the voltage level at power supply 64 matches a predetermined threshold voltage (step 76).

In the present invention, the threshold voltage is determined to be the voltage level that indicates that there is sufficient power in power supply 64 to perform a set of operations used by camera 10 to capture an image. As defined herein the set of image capture operations includes at least a take picture operation shown in Fig. 4 and a film wind operation shown in Fig. 5. These and other operations that can optionally be included in the set of image capture operations considered when determining a threshold voltage will be described in greater detail below. By way of introduction, the operations can also include a standby operation shown in Fig. 3, and a film rewind operation shown in Fig. 6. Energy is consumed in performing each of these steps. Accordingly, the threshold voltage used to determine whether there is sufficient power in power supply 64 to completely perform at least a minimum combination of the steps of the set of image capture operations.

Table 1 illustrates how this threshold voltage can be determined. Table 1 shows the voltage thresholds for the operation of various components of camera 10.

25

Table 1: Voltage Level Requirements:

Control system element	Minimum voltage at power supply for operation of element.
Motorized film drive system (54)	2.3 volts
Shutter system (52)	2.2 volts

Controller (30)	2.0 volts
Scene Illumination Detector (44)	2.0 volts
Flash System (56)	1.6 volts
Mid-Roll Rewind Input (46)	1.2 volts
Film Door Position detector (48)	1.2 volts

As can be seen from this, a voltage level at power supply 64 that is below 2.3 volts indicates that there is insufficient power stored in power supply 64 to permit
5 motorized film drive system 54 to complete the operation associated with advancing photographic film from one position to another. Similarly, a voltage at the terminals of power supply 64 of 2.2 volts indicates that there is insufficient power stored in power supply 64 to permit shutter system 52 to complete an exposure operation. However, under both of these conditions, there is still
10 sufficient power to operate controller 30, scene illumination detector 44, flash system 56, mid-roll rewind input 46, and other components of camera 10 not shown in Table 1.

There are many steps in the set of image capture operations, each step is performed to complete the process. Each of these operations consume
15 power when more than one step is to be performed. To capture an image, it is necessary to ensure that there will be sufficient power remaining in power supply 64 after the performance of the operations in the set of image capture operations to permit any subsequent steps to be performed. In accordance with the present invention, the set of image capture operations are not performed unless it is first
20 determined that there is sufficient energy available in power supply 64 to execute each step in the set of image capture operations. For example, it will be noted that the operation of shutter system 52 requires the second largest amount of energy that is required by any component of camera 10 and that the operation of
25 motorized film drive system 54 which occurs after an operation of shutter system 52. Thus, if controller 30 were programmed to use a threshold voltage of 2.3 volts and the power remaining in power supply 64 was such that power supply 64 could

maintain 2.3 volts at the start of the set of image capture operations, it could occur that the operation of shutter system 52 consumes so much of the energy remaining in power supply 64 that when the set of image capture operations reached the step of activating the motorized film drive system 54, the voltage at power supply 64 is
5 below 2.3 volts, a level that is insufficient to operate the motorized film drive system 54.

Thus, in the present invention the threshold voltage is set at a level that indicates that power supply 64 has enough stored energy to allow all of the steps of the set of image capture operations to be performed. If the voltage at
10 power supply 64 is below this threshold, controller 30 executes a delay (step 74) without executing any part of a set of image capture operations. This camera inactivity provides an intuitive indication to the user of camera 10 that the power supply 64 does not have sufficient energy to execute the set of image capture operations.

15 If it is determined that the voltage at power supply 64 is above the threshold voltage, controller 30 sends a signal to motorized film drive system 54 causing motorized film drive system 54 to advance film 18 to the first usable picture area which is known as the first frame. Thus, camera 10 is now ready to perform the standby operations shown in Fig. 3. If it is determined that the
20 voltage of power supply 64 is below the threshold voltage, then a delay is executed (step 74) and voltage levels are retested. Camera 10 cannot capture images when this occurs in this way. Camera 10 does not perform a partial image capture operation leading a user to possibly to possibly conclude that there has been a camera malfunction caused by a problem that requires a repair.

25 As is shown in Fig. 3, during the standby operations, controller 30 sends a signal to flash system 56 causing flash charging circuit 58 to store energy for use in flash photography (step 80). In cameras having a mid-roll rewind input 46, a check is performed to determine if mid-roll rewind input 46 is generating a signal indicating that film 16 should be rewound. If the mid-roll rewind signal is
30 detected by controller 30, controller 30 performs the rewind operations described in Fig. 6 (step 82). If the mid-roll rewind switch is not detected, controller 30

determines whether a shutter trigger signal has been generated indicating that a user wants to capture an image (step 84).

Where the shutter trigger signal is not received, controller 30 executes a delay for period of time (step 86) after which controller 30 again

5 determines whether a shutter trigger signal has been generated. When the user of camera 10 causes the shutter trigger input 42 to transmit the shutter trigger signal, controller 30 causes flash charging circuit 58 to stop the charging of the flash (step 88). This reduces the amount of power drawn from the power supply 64 during the subsequent steps.

10 The voltage level at power supply 64 is again monitored to determine if the voltage is above the threshold (step 90). If the voltage at power supply 64 is not above the threshold voltage, controller 30 does not proceed to the take picture operations. In this way, the power available for image capture operations is checked immediately before controller 30 attempts to execute the
15 instructions for performing the image capture operations. If the voltage at power supply 64 is above the threshold, controller 30 proceeds to the take picture operations shown in Fig. 4.

When controller 30 determines that the take picture operations are to be performed, controller 30 examines signals provided by scene illumination
20 detector 44 to controller 30 to determine a scene illumination level (step 92). Where the scene illumination is determined to be bright, controller 30 transmits a signal that causes shutter system 52 to expose film 18 to light from the scene for a predetermined period of time that is appropriate for recording useful images of bright scenes on film 18 (step 94). Where controller 30 determines that the scene
25 illumination is not bright, controller 30 transmits a signal causing shutter system 52 to expose film 18 for a period of time that is sufficient for capturing useful images of scenes that are not bright (step 96). Typically, shutter system 52 exposes film 18 for a period of time that is relatively longer than the period of time that is used for capturing images of scenes that are bright.

30 In the embodiment shown, controller 30 also transmits a signal to flash trigger circuit 60 which releases flash energy stored in flash charging circuit

58 to flow through flash lamp 62 causing a flash of light (step 98). In this embodiment of camera 10, controller 30 is programmed to cause a flash of light to be triggered with each image. However, this is not necessarily so. In an alternative embodiment, controller 30 can evaluate the scene brightness and can selectively elect to whether to cause flash trigger circuit 60 to permit a flash discharge based upon this evaluation.

After the flash is fired, controller 30 samples the signal generated by shutter trigger input 42 and determines if the camera user has released shutter trigger input 42 from an image capture position. If shutter trigger input 42 has not been released controller 30 executes a delay (step 102) and again determines whether shutter trigger input 42 has been released (step 100). When shutter trigger input 42 is released, controller 30 executes the film wind operations described in Fig. 45.

Referring to Fig. 5, controller 30 determines a film advance period (step 110). This can be determined by accessing information in memory 32. Controller 30 then causes motorized film drive 54 to advance film 18 in a forward direction (step 112). Controller 30 monitors signals from film metering sensor 49 to detect movement of film 18 and uses the detected film movement to determine when film 18 is properly advanced or metered (step 114). Controller 30 continues running motorized film drive system 54 until the film advance period ends (step 118) or until it is determined that film 18 has been moved one full image frame (step 114). When film 18 has advanced one full frame, film 18 is positioned to capture another image and controller 30 stops motorized film drive 54 (step 116). Controller 30 goes to the standby operations Fig. 3.

If controller 30 determines that motorized film drive system 54 has been operating for the entire film advance period without detecting movement of film 18, then controller 30 assumes that film 18 is jammed or that the end of the film roll has been reached. Controller 30 stops motorized film drive system 54 from advancing film 18 (step 120) and proceeds to the rewind operations shown in Fig. 6.

Referring to Fig. 6, controller 30 in the rewind operation disables flash charging (step 122), starts motorized film drive system 54 in the reverse direction (step 124), and determines a film rewind time (step 126). Controller 30 monitors the signal generated by film metering sensor 49 during this time and
5 determines if film 18 moves in response to operation of motorized film drive system 54 (step 128). If film metering sensor 49 detects film movement when motorized film drive system 54 is operated, then controller 30 knows that film 18 is moving in film metering area 26. It will be appreciated that during this time film 18 is in one of two states. In one state film 18 is fully rewound on, for
10 example, a film spool inside a housing (not shown) and in the other state, the film is not rewound into the housing. Controller 30 can detect if film 18 is not wound into the film housing by monitoring film metering sensor 49 to detect film movement. When film movement occurs, controller 30 runs motorized film drive system 54 in the reverse direction for an additional time period (step 132) and
15 loops back to determine if movement (step 128) and, to check if film 18 has started moving again (step 128). If no film movement is determined, the program continues to monitor the film drive run time (step 130). If the run time is greater than or equal to the rewind time, film 18 is considered rewound and, controller 30 stops motorized film drive system 54 (step 134), starts the charging of the flash
20 (step 136), and proceeds to the film initialization operation.

As the preceding descriptions of Figs. 2 - 6 show, the power remaining in power supply 64 is checked before a picture sequence is initiated and before film advancement during initialization is started. This insures that power supply 64 has enough power to complete both of these two activities when
25 performed together. Power supply 64 is not checked before initiating a film winding operation because film wind occurs immediately after the picture taking operation where the battery status was just checked and because the threshold voltage used in determining whether there is sufficient power in power supply 64 before the set of image capture operations was established with consideration that
30 there should be sufficient energy in power supply 64 to complete the take picture operation and the film wind operation. In an alternate embodiment, the threshold

voltage is determined based upon the amount of power required to execute the take picture, film wind and film rewind operations. In still another alternate embodiment, the threshold voltage is determined based upon the amount of power required to execute the standby, take picture, and film wind operations. Other
5 combination of such operations can be used.

In another embodiment of the present invention shown in Fig. 7, voltage detecting circuit 66 controls a power control switch 140 such as a relay, transistor, or other like switching device. Power control switch 140 is connected in series between power supply 64, controller 30, input systems 40 and/or
10 controlled systems 50. In circumstances where voltage detecting circuit 66 determines that the voltage that power supply 64 does not meet the threshold voltage, voltage detecting circuit 66 transmits a signal to power control switch 140 which prevents power from being supplied to controller 30, input systems 40 and controlled systems 50. This disables camera 10 where it is determined that there is
15 insufficient power remaining in power supply 64 to fully executes the set of image capture operations. Alternatively, this arrangement can also be used to selectively disable controlled systems 50 so that controller 30 and input systems 40 can continue to operate. For example camera 10 can optionally incorporate a warning or alarm that can be used to indicate that there is insufficient power in power
20 supply 64 to permit operation of camera 10. It will also be appreciated that in this embodiment, the voltage detecting circuit 66 and power control switch 140 combine to control whether camera 10 operates.

Fig. 8 shows still another embodiment of the present invention. In this embodiment, shutter trigger input 42 acts as an input that activates voltage
25 detecting circuit 66. When voltage detecting circuit 66 detects a voltage level at power supply 64 indicating that there is sufficient power in power supply 64 to execute all of the set of image capture operations, voltage detecting circuit 66 transmits a signal to controller 30 which then executes the set of image capture operations. However, where shutter trigger input 42 does not activate voltage
30 detecting circuit 66 or where an activated voltage detecting circuit 66 does not detect sufficient voltage in power supply 64 to permit completion of the set of

image capture operations, no signal is sent to controller 30, and therefore no image capture operations are attempted.

Image capture system 12 has been described herein in the context of a film camera. However, image capture system 12 can also comprise a hybrid
5 film/electronic image capture system or an electronic image capture system such as any conventional digital image capture system that uses a solid state imager to capture images of a scene in a digital or analog electronic form as are known in the art. One example of such an image capture system is described in commonly assigned and co-pending U.S. Patent Application Serial No. 10/028,644, entitled
10 "Method and Camera System for Blurring Portions of a Verification Image to Show Out of Focus Areas in a Captured Archival Image", filed on December 21, 2001, by Belz, et al. incorporated herein by reference. Where image capture system 12 comprises such an electronic image capture system, image capture system 12 will operate in the same fashion with the threshold voltage being
15 established at a level sufficient to complete the set of image capture operations.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention. For example, in Fig. 1, shutter trigger input 42 is described as a single switch that the
20 user activates to provide a shutter trigger signal to controller 30. Controller 30 then determines whether there is sufficient power available in power supply 54 for the entire set of image capture operations, including operation of shutter system 52, to be performed. Alternatively, as is in prior art U.S. Patent No. 6,134,391 issued October 17, 2000 in the name of Takahashi, the shutter trigger input can be
25 two switches that when successively activated provide first and second trigger signals to begin a battery residual-power check and to operate the shutter, assuming there remains sufficient power in the battery. Thus, shutter trigger input 42 in Fig. 1 can have two switches that when successively activated provide first and second trigger signals to controller 30. Controller 30 would determine
30 whether there is sufficient power available in power supply 54 for the entire set of image capture operations to be performed, when receiving the first trigger signal.

If controller 30 determines there is sufficient power available in power supply 54 for the entire set of image capture operations to be performed, when receiving the first trigger signal, then upon receiving the second trigger signal shutter system 52 would be operated. Conversely, if controller 30 determines there is not sufficient
5 power available in power supply 54 for the entire set of image capture operations to be performed, when receiving the first trigger signal, then upon receiving the second trigger signal shutter system 52 would not be operated. Of course, a visible insufficient-power warning, such as a flashing LED, could be energized to alert the user.

PARTS LIST

	10	camera
	12	image capture system
	14	control system
5	16	taking lens unit
	18	film
	20	film chamber
	22	camera body
	24	film door
10	26	film metering area
	30	controller
	32	memory
	40	input systems
	42	shutter trigger input
15	44	scene illumination detector
	46	mid-roll rewind input
	48	film door position detector
	49	film metering sensor
	50	controlled systems
20	52	shutter system
	54	motorized film drive system
	56	flash system
	58	flash charging circuit
	60	flash trigger circuit
25	62	flash lamp
	64	power supply
	66	voltage detecting circuit
	70	initialize step
	72	film door closed determination step
30	74	delay step
	76	voltage level threshold determining step

- 78 advance film step
- 80 start flash charger step
- 82 mid-roll rewind signal detecting step
- 84 trigger signal detecting step
- 5 86 delay step
- 88 stop flash charger step
- 90 voltage level threshold determining step
- 92 determine scene illumination level step
- 94 output short exposure pulse step
- 10 96 output long exposure pulse step
- 98 fire flash step
- 100 detect trigger signal step
- 102 delay step
- 110 film advance time determining step
- 15 112 runs film drive and forward direction step
- 114 determine rewind time step
- 116 determine film metering step
- 118 stop film drive step
- 122 determine film drive run time greater than film advance time
- 20 124 stop film drive step
- 126 disable flash charger step
- 128 run film drive in reverse direction step
- 130 determine rewind time period step
- 132 determine film movement step
- 25 134 reset rewind time period step
- 136 determine film drive run time greater than rewind time period step
- 138 stop motor step
- 139 start flash charger step
- 140 power control switch
- 30

CLAIMS:

1. A camera for use with a power supply, the camera comprising:
a voltage detecting circuit adapted to detect a voltage level at the
power supply and to generate a voltage level signal;
5 an image capture system for performing a set of image capture
operations; and
a controller that receives the voltage level signal and prevents the
image capture system from capturing an image when the voltage level signal
indicates that there is insufficient power available in the power supply to perform
10 all of the operations in the set of image capture operations.
2. The camera of claim 1, wherein the image capture system
captures images on a photographic film.
- 15 3. The camera of claim 2, wherein the set of image capture
operations includes a picture taking operation and a film wind operation.
4. The camera of claim 3, wherein the set of image capture
operations includes a standby operation.
20
5. The camera of claim 3, wherein the set of image capture
operations includes a film rewind operation.
6. The camera of claim 1, wherein the controller comprises a
25 power control switch.
7. The camera of claim 1, wherein the controller comprises a
microprocessor.
- 30 8. The camera of claim 1, wherein the image capture system
comprises an image capture system for capturing electronic signals.

9. A camera having a power supply, the camera comprising:
a trigger circuit adapted to generate a trigger signal;
a voltage detecting circuit adapted to detect voltage levels at the
5 power supply and to generate a voltage level signal; and
an image capture system for executing a set of image capture
operations capturing images in response to a capture signal from a controller;
wherein the controller receives the trigger signal and the voltage
level signal and generates a capture signal when the trigger signal is received and
10 the voltage level signal indicates that there is sufficient power available in the
power supply to perform the image capture operation.
10. The camera of claim 9, wherein the image capture system
comprises a shutter system for controllably exposing a photosensitive film to light
15 from a scene a film drive system and wherein the set of image capture operations
include a film exposure operation and a film advance operation.
11. The camera of claim 9, wherein the image capture system
comprises a shutter system for controllably exposing a photosensitive film to light
20 from a scene a film drive system and wherein the set of image capture operations
include a film exposure operation and a film rewind operation.
12. The camera of claim 9, wherein the image capture system
comprises a shutter system for controllably exposing a photosensitive film to light
25 from a scene a film drive system and wherein the set of image capture operations
include a film exposure operation and a film wind operation and a standby
operation.
13. A camera for use with a power supply, the camera comprising:
30 a trigger circuit generating an activation signal;

a voltage detecting circuit adapted to measure the voltage in the power supply and to generate a trigger signal when the voltage in the power supply indicates that the power supply has at least a minimum amount of power; and

an image capture system adapted to capture an image in response to
5 the trigger signal,

wherein the minimum amount of power required is sufficient to complete a set of image capture operations used by the image capture system to capture an image.

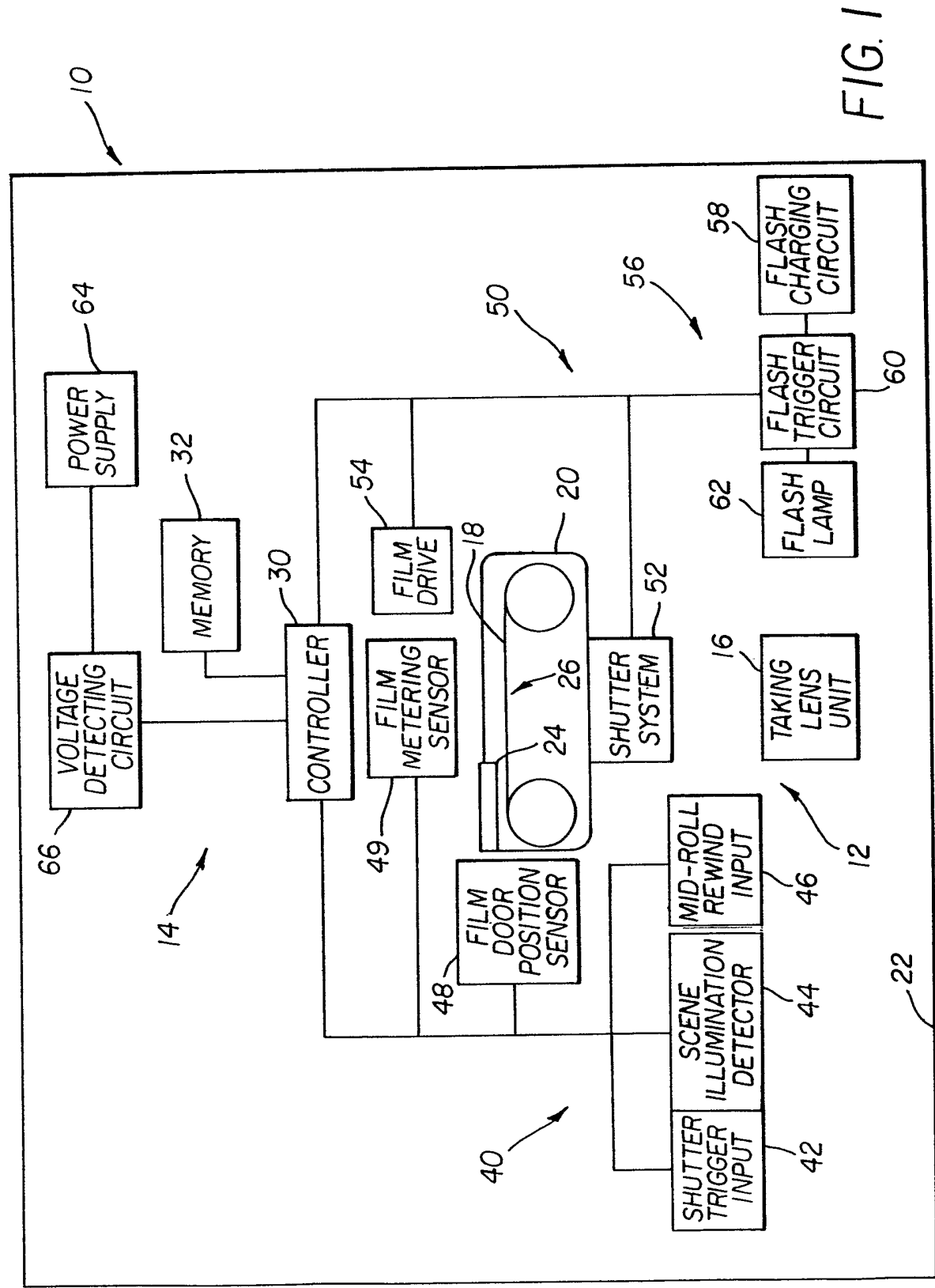
10 14. The camera of claim 13, wherein the camera further comprises a trigger input and said image capture system is adapted to measure the voltage in the power supply only when the activation signal is received.

15 15. A method for operating an image capture system of the type having a power supply, the method comprising the steps of:
detecting a trigger signal;
measuring the voltage level of the power supply; and
performing a set of image capture operations only when a trigger
signal is detected and the measured voltage level indicates that the power supply
20 has sufficient power to permit completion of the set of image capture operations.

16. The method of claim 15, wherein the set of image capture operations includes a film exposure and a film winding operation.

25 17. The method of claim 15, wherein the set of image capture operations includes a film exposure and a film rewinding operation.

18. The method of claim 15, wherein the set of image capture operations includes a film exposure, a film winding operation and a standby
30 operation.



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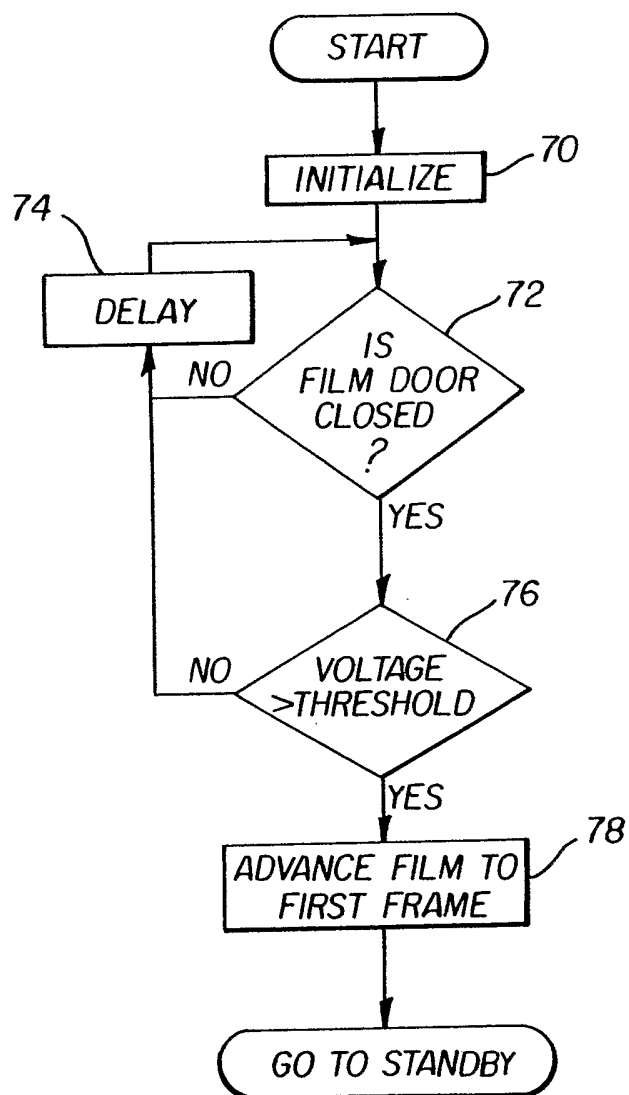


FIG. 2

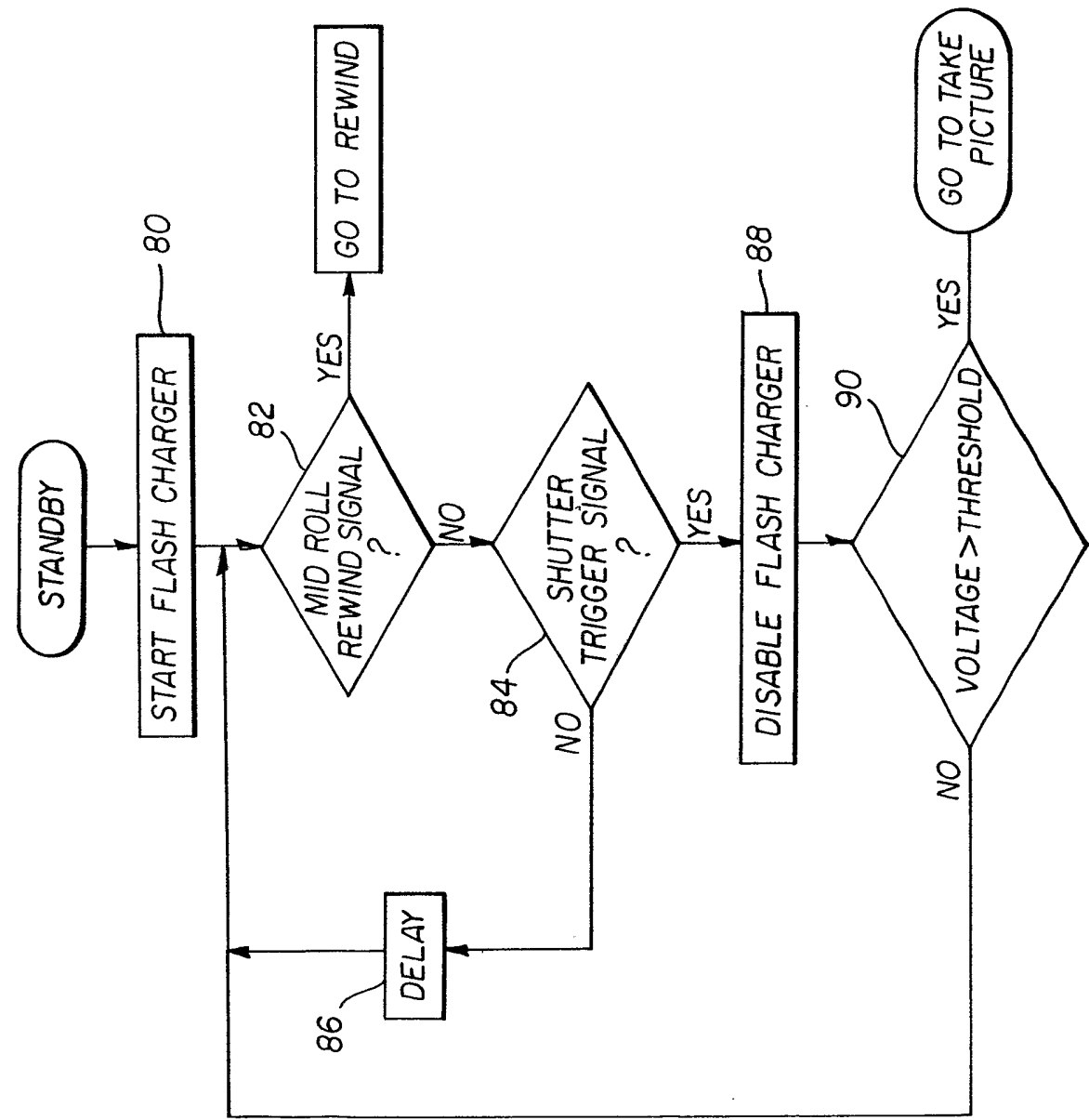


FIG. 3

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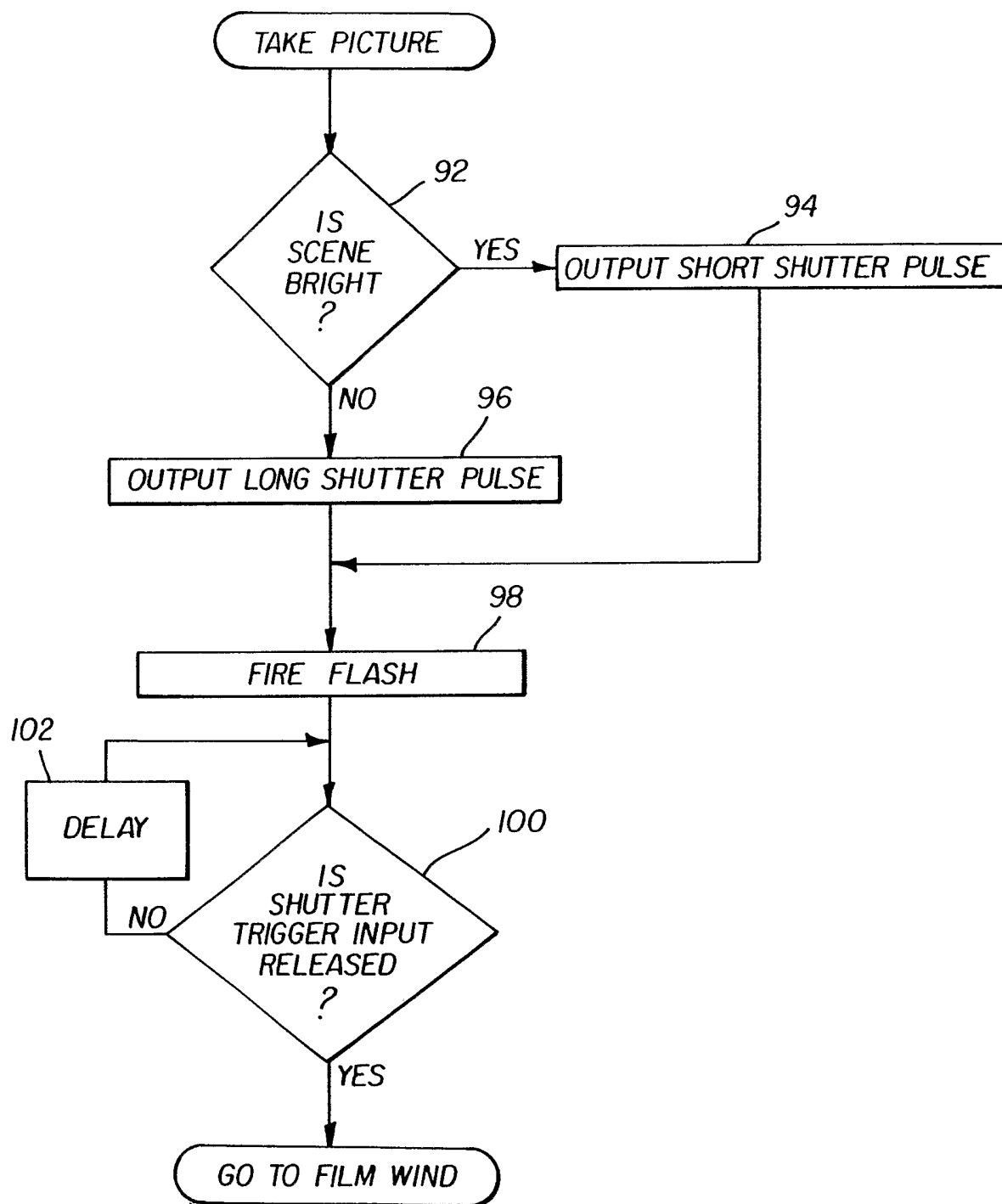


FIG. 4

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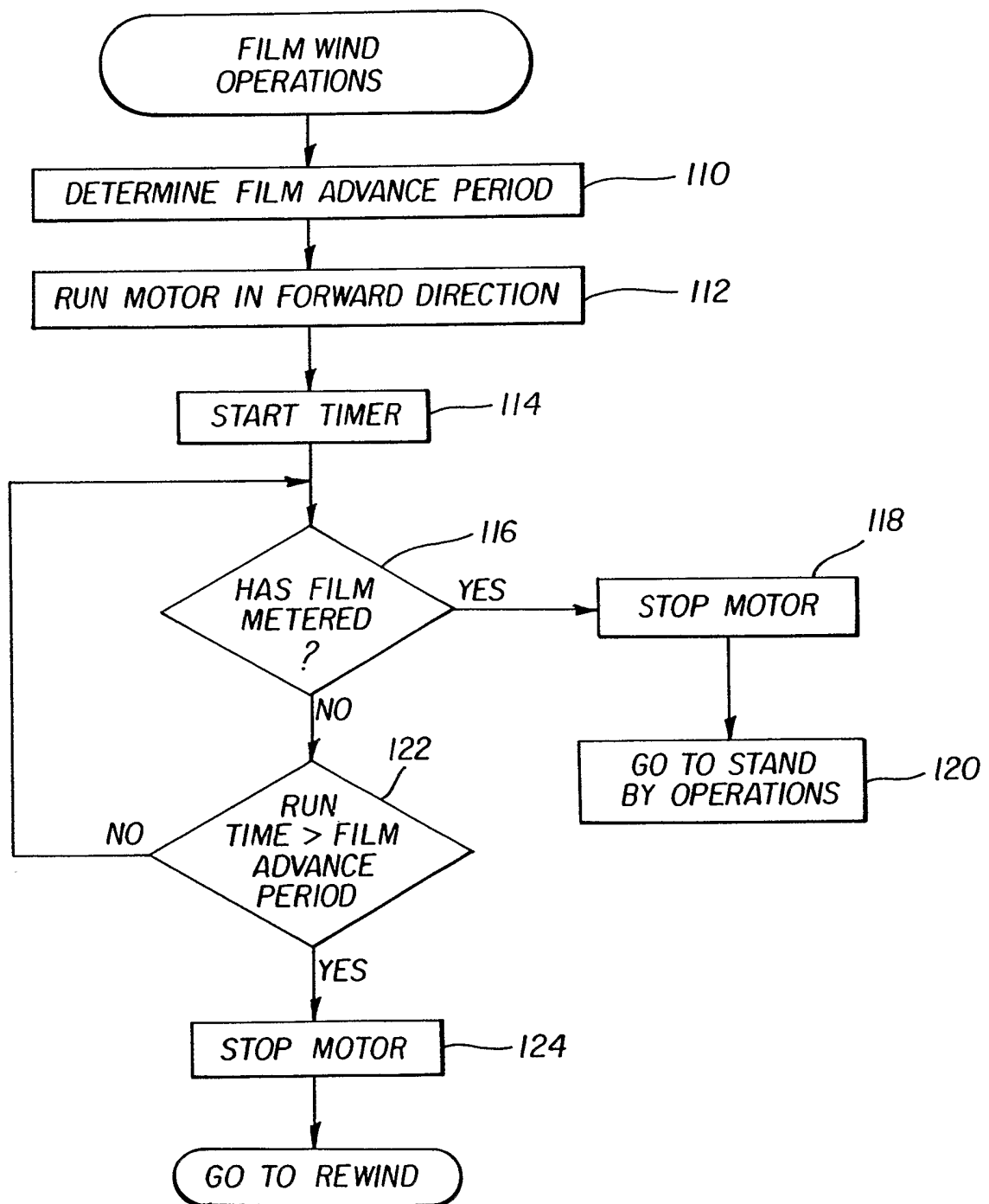


FIG. 5

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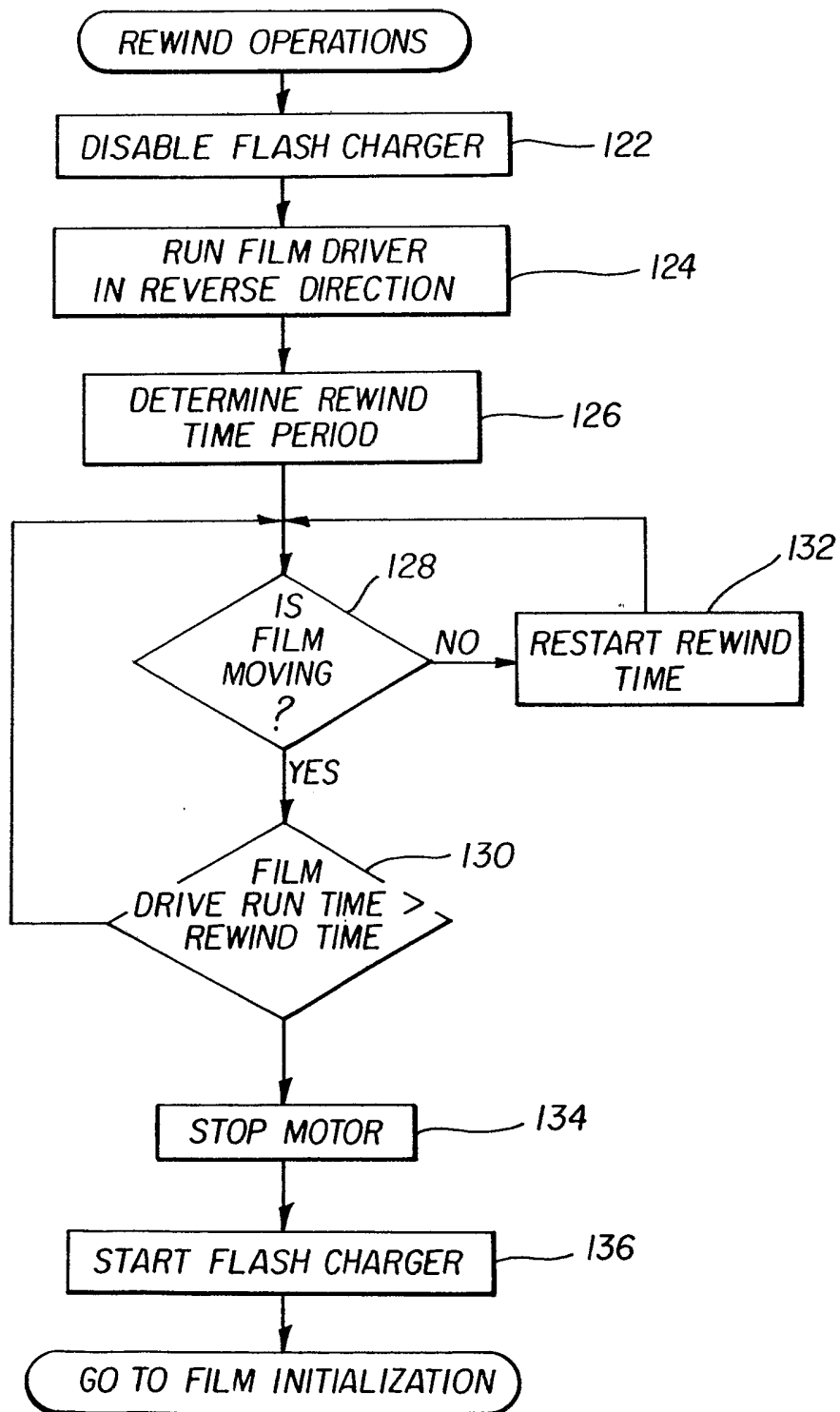


FIG. 6

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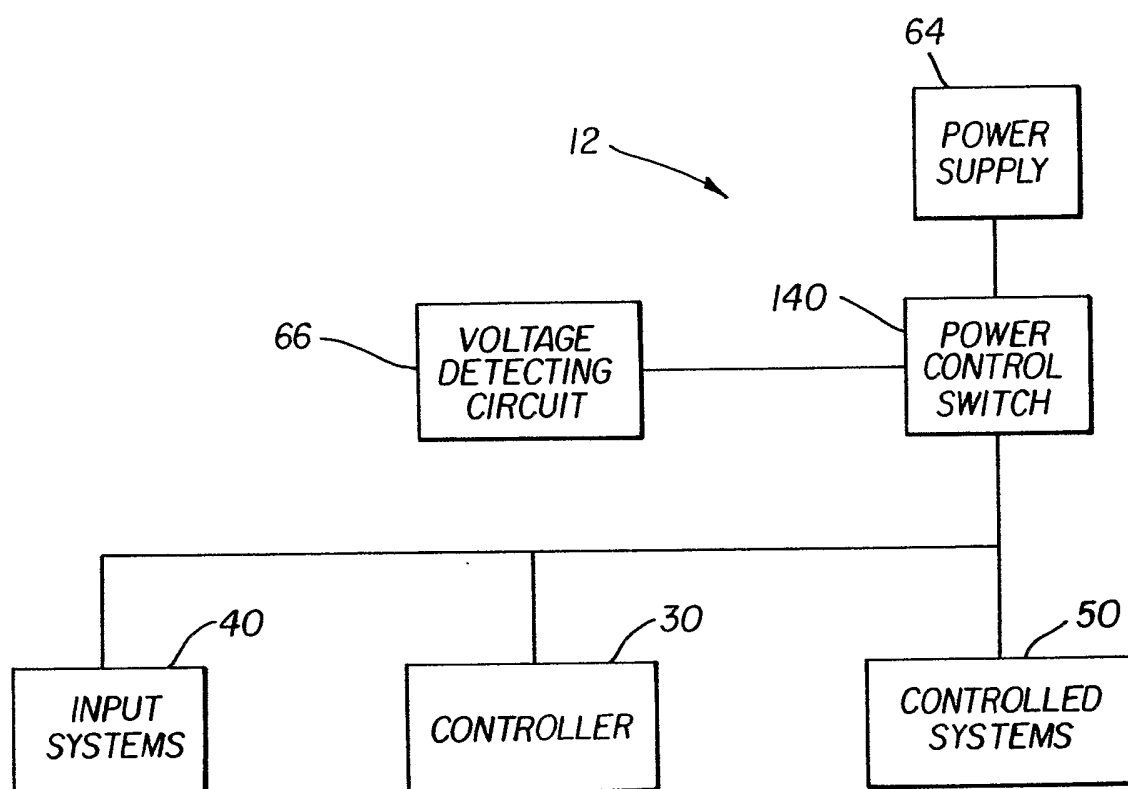


FIG. 7

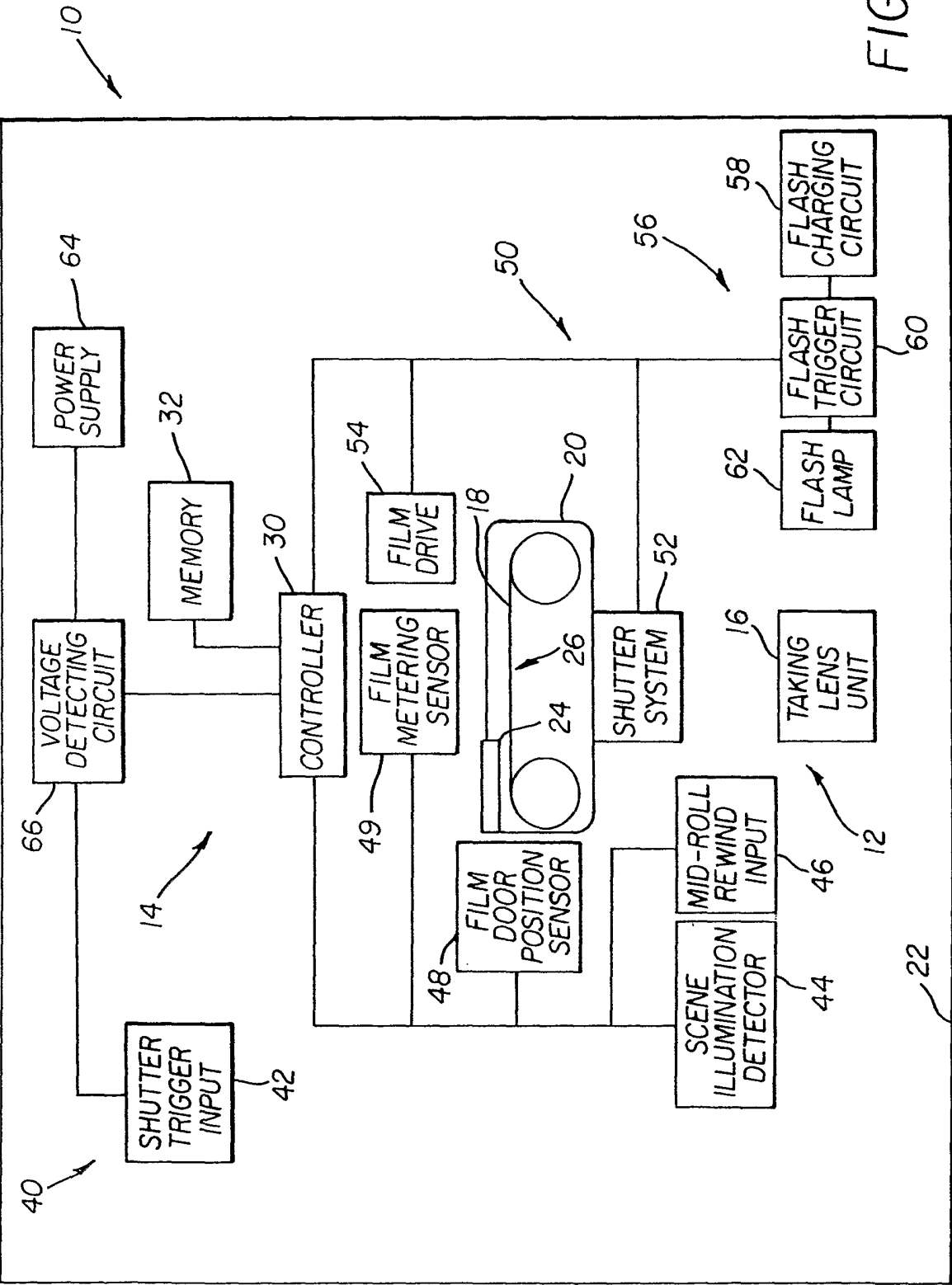


FIG. 8

INTERNATIONAL SEARCH REPORT

ational application No

/US2005/040455

A. CLASSIFICATION OF SUBJECT MATTER
G03B7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/126105 A1 (DOWE DAVID R ET AL) 1 July 2004 (2004-07-01) paragraphs '0024! - '0055!; claims 1-18; figures 1-8	1-18
A	----- US 5 023 470 A (ONOZUKA ET AL) 11 June 1991 (1991-06-11) cited in the application the whole document	1-18
A	----- US 5 027 150 A (INOUE ET AL) 25 June 1991 (1991-06-25) cited in the application the whole document ----- -/--	1-18

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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G document member of the same patent family

Date of the actual completion of the international search

1 March 2006

Date of mailing of the international search report

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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Bähr, A

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4 611 898 A (MATSUYAMA ET AL) 16 September 1986 (1986-09-16) the whole document -----	1-18

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Information on patent family members

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